

ARIZONA BIOMASS ENERGY OPPORTUNITIES

An Information Paper Prepared by TSS Consultants for the

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SUMMARY

In Arizona's wildland areas, combustion by a wildfire or prescribed burn, harvesting for a product, restoration treatment or use in a biomass power generation facility, or release to achieve old growth forest conditions is the ultimate fate of excess forest fuel biomass. Both wildfires and prescribed burning emit significant volumes of air pollutants. Burning these wildland fuels in a biomass power plant reduces air pollutants by more than two thirds (Figure 1). The development of new biomass power plants can also help Arizona meet the renewable energy mandate as stipulated in the state's Environmental Portfolio Standard (EPS) – 1.1% of the state's energy by 2007. In addition to improving air quality, addressing wildland fuel treatments and providing a new renewable source of energy, the biomass power industry could supply much needed employment opportunities – especially in rural areas of Arizona. Lastly, biomass power is a cost effective, 24/7 renewable energy source that is cost competitive with other renewable energy sources (Table 1). Although cost alone is not and should not be the deciding factor, biomass power can reduce the overall average costs of a renewable portfolio mix. However, proposals for new biomass power plants to generate electricity are missing in Arizona's renewable electrical supply planning. Biomass should become a cost effective baseload energy source and provide net environmental improvements as part of Arizona's future renewable electric supply and forest health restoration treatments.

BACKGROUND

BIOMASS POWER: Biomass fuels come from organic matter in trees, agricultural crops and other living plant material. Carbohydrates are the organic compounds that make up biomass. These compounds are formed in growing plant life through photosynthesis, a natural process by which energy from the sun converts carbon dioxide and water into carbohydrates, including

sugars, starches and cellulose. The wood carbohydrates can be converted to energy to produce electricity through thermal oxidation in a boiler, pyrolysis or gasification.

Biomass power plants using thermal oxidation in a boiler were first conceived and constructed during the 1940's in Oregon. The purpose of the initial 30 MW plant was to divert sawmill waste from disposal into a controlled efficient oxidation process that would significantly reduce air pollution in the Willamette Valley.

Arizona, like Oregon, has large volumes of wildland fuels that, if not burned in wildfires or prescribed burns, could be available for biomass power plants. Public benefits include: new jobs in rural areas (where unemployment rates are typically very high); decreased air pollutants from wildfires and prescribed burns; reduction in global warming gases; creation of new renewable supplies to help meet Arizona's renewable energy mandates as stipulated in the EPS; reducing dependence on fossil fuels, both foreign and domestic; and enhanced efficiency of forest restoration efforts. In addition, biomass from range restoration activities (removal of overstocked stands of pinon and juniper trees) and urban wood wastes could be available to supplement the wildland/forest fuels in new biomass power plants. This could result in further reduction of open field burning and reduction of wood wastes now being deposited into landfills.

BIOMASS IS THE DOMINANT RENEWABLE ENERGY IN THE US AND THE WORLD:

Biomass sources provide about 3 percent of all energy consumed in the United States while supplying more than half of all renewable energy generated in the country. Biomass supplies more than six times the energy output of geothermal, solar and wind energy sources combined. Globally, biomass meets about 14 percent of the world's energy needs.

However, proposals for new biomass power plants to generate electricity are missing in Arizona's renewable electrical supply planning. Biomass can become a cost effective and significant part of Arizona's future renewable electric supply.

ARIZONA POTENTIAL

ARIZONA WILDLAND BIOMASS POTENTIAL: Arizona has approximately 19.4 million acres of wildland forests susceptible to wildfires, with 7.95 million acres in private lands and 11.45 million in public lands. Over 27% of Arizona's territory is considered forest. (See attached forest cover map.) Four woody biomass fuel sources are available in Arizona: forest products manufacturing residuals; forest biomass (both logging residue, forest restoration thinning, and hazardous fuels reduction); urban wood waste; and range restoration residues.

ARIZONA WILDLAND BIOMASS VOLUMES ARE INCREASING: Arizona has a major biomass waste disposal problem, primarily due to the lack of viable disposal alternatives. Currently there is only one operating biomass power generation facility – Western Renewable Energy in Eager, Arizona. Lacking a viable biomass utilization infrastructure, most entities are addressing biomass disposal one of three ways: leaving the material onsite; open burning; or disposal in landfills. Three factors are increasing the volume of biomass wastes, particularly in the urban waste stream and forests/rangelands:

1. Overgrazing and the implementation of organized wildland fire suppression have caused increased wildland fuel accumulations. Prior to settlement of the West by Europeans, frequent wildfires caused by lightning or Indians burned until they reached a fire barrier, ran out of fuel, or the weather put them out. These low-

intensity wildfires decreased the volumes of trees per acre. Overgrazing removed the fine fuel carrier and with widespread suppression, these fuels now accumulate and lead too much more intense and catastrophic wildfire.

2. Annually, more state, federal and local limitations are placed on open burning and prescribed fire on wildlands. These new laws and regulations reduce the alternatives for biomass disposal while at the same time increasing the costs of non-burning disposal. Limiting disposal alternatives and increasing the disposal costs will contribute to making these materials economically available for use in biomass facilities.
3. Arizona has a growing population of 5.4 million citizens, each generating about one ton of urban waste annually. As population increases, so do the volumes of urban wood wastes.

The opportunities for creating an Arizona biomass power industry rest on diverting potential fuels for new biomass facilities from wildland fuel treatments, range restoration biomass from open burning, and urban wastes from landfills, with the greatest volumes coming from wildland fuel treatments. The avoided costs and losses from wildfires (and disposal of agricultural residues that are open burned) offer significant economic and environmental benefits by using biomass as feedstock for the generation of renewable electricity.

Examples of wastes that should be used as raw material in biomass energy facilities include:

- Biomass harvested to reduce wildfire fuel loading from Arizona wildlands.
- Logging residues and thinnings harvested rather than burned to protect homes and other high value environmental and economic assets from catastrophic wildfires.
- Range restoration generated biomass used as a biomass raw material in lieu of open burning.
- Urban wood wastes diverted from landfills to biomass power plants.

BIOMASS PUBLIC BENEFITS

Each renewable energy resource has similar but different public benefits. Solar, geothermal, wind, landfill gas and biomass are all renewable resources for generating electricity that can be compared with fossil fuels. However, biomass has additional public benefits such as fuel load reduction in wildfire prone areas. Following are specific public benefits that can result from including biomass power plants in Arizona's renewable electricity supply plan.

CREATES NEW JOBS IN RURAL AREAS WITH HIGH UNEMPLOYMENT: With current high unemployment rates in rural Arizona, attracting private investment in new biomass power facilities will create new jobs, new taxes for local and state governments, and help to reduce economic decline in many Arizona communities.

REDUCES COSTS AND LOSSES FROM WILDFIRES: In Arizona's wildland areas, eventually all excess forest fuels will be burned. Using these wildland fuels in new biomass power plants can significantly reduce loss of life and property, suppression costs, and insurance losses from

wildfires. Reducing catastrophic wildfires will also help to preserve the tourist-based economies of many Arizona communities. Blackened landscapes are not attractive and only serve to diminish recreational opportunities and attributes, not to mention reduce wildlife habitat values.

REDUCES ACID RAIN AND HAZE: Efficient combustion of biomass results in low emissions of sulfur dioxide (SO₂) and production of fewer volatile organic compounds (VOC) when compared to emissions from facilities that burn coal or oil. Air pollution from burning fossil fuels is a major cause of acid rain. Emissions of SO₂ and nitrogen oxide (NO_x) react in the atmosphere with water, oxygen and oxidants to form acidic compounds (sulfuric acid and nitric acid). Some of these compounds fall to earth in the form of acid rain, snow or fog. Acid rain increases the acidity of lakes and streams and damages trees at high elevations, and accelerates the decay of building materials and paints.

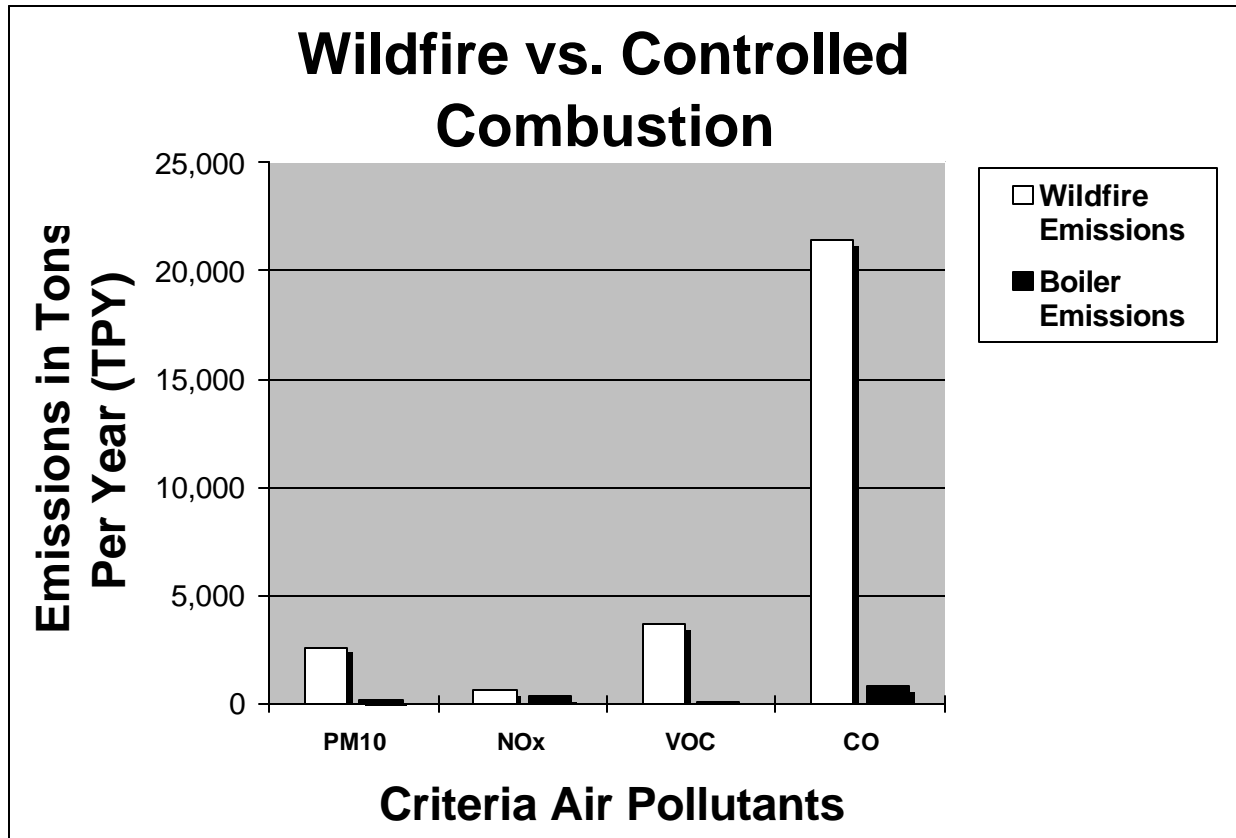
Aside from their contribution to acid rain, SO₂ and NO_x and their particulate matter derivatives (sulfates and nitrates) also contribute to smog and endanger public health. Tighter control of these emissions is desirable in areas with frequent smog problems and in areas identified for their pristine environmental qualities. Sensitive air sheds such as the Grand Canyon and Sedona areas represent prime view sheds and reduction of haze due to fossil fuel combustion and wildfire can be achieved in the long term through the creation of a biomass energy industry.

REDUCES GLOBAL WARMING: The use of biomass for energy causes no net increase in carbon dioxide emissions to the atmosphere. As trees and plants grow, they remove carbon from the atmosphere through photosynthesis. If the amount of new biomass growth balances the biomass used for energy, then biomass energy is considered carbon dioxide "neutral." Thus, the use of biomass for energy does not increase carbon dioxide emissions and does not contribute to the risk of global climate change. Using biomass to produce energy is a way to dispose of waste materials that otherwise would create environmental risks.

IMPROVES FOREST ECOSYSTEM HEALTH: Heavy accumulations of forest fuels has limited the size and health of trees and related ecological systems in many of Arizona's forests. For example, the ecosystem health of large areas of forestland has deteriorated in the Prescott, Showlow, Williams, Flagstaff and Payson areas. Throughout the Western United States, natural ecosystems have been significantly altered, creating a high risk to forest ecological systems from intense wildfire due to excessive and unnatural fuel accumulations. Selective thinning for forest restoration and supplying fuel for new biomass power plants will improve the general health and reduce wildfire risk to remaining trees. With less competition for nutrients and water, remaining trees will have a better chance of maturing into old growth stands.

REDUCES AIR POLLUTANTS FROM WILDFIRES AND PRESCRIBED FIRES: Wildfires produce large volumes of air pollutants. Reducing wildfire intensity, duration and damages by using forest fuels to supply biomass power plants significantly reduces air pollutants that occur when the material is burned in the open. As displayed in Figure 1 below, air pollutants are reduced to a fraction of what they would be in a wildfire when compared to combustion in a biomass power plant. Although prescribed burning is essential to maintenance of many forest ecosystems and generally releases significantly lower amounts of air pollutants as compared to a wildfire, combustion of the fuels in a biomass plant will result in a net reduction of atmospheric pollution, especially at the local scale.

Figure 1. WILDFIRE & BIOMASS POWERPLANT EMISSIONS
 (Based On U.S. EPA AP-42 Emission Factors In The Southwest &
 A New 20MW Biomass Plant)



BIOMASS POWER CAN REDUCE RENEWABLE ENERGY PORTFOLIO AVERAGE COSTS

COSTS OF BIOMASS AND OTHER RENEWABLES: Solar, wind, geothermal and biomass are all complementary components of a complete renewable electric portfolio. Each resource has its benefits and limitations. Any one renewable energy source by itself may not deliver the optimum mix of public benefits required by the ratepayer's investments. All renewable resources should be pursued in order to obtain the most cost effective return to the ratepayer.

Based on energy costs only, wind is the cheapest source among these renewables. However, taking reliability into account in obtaining baseload power or the average cost/KWH, geothermal and biomass are the lowest cost renewable resources. Thus, in a mix of renewable resources,

biomass can reduce substantially the average cost/KWH. Table 1 below displays cost comparisons.

Table 1. Delivered Average MW Renewable Electrical Comparisons

Renewable Source	Cost/KWH	Cost/Average KWH
Solar	15 – 30 cents	45 –90 cents
Wind	4-5 cents	16 – 20 cents
Biomass (wood wastes)	6.5 – 10 cents	6.5 – 10 cents
Geothermal	5 - 7 cents	5 - 7 cents

Although cost alone is not and should not be the deciding factor, biomass has some cost advantages over other renewables. Biomass can reduce the overall average costs of a renewable portfolio mix in support of Arizona's EPS.

CONCLUSION

The Arizona Corporations Commission now has a key opportunity to deliver a number of public benefits to the citizens of Arizona by modifying the Environmental Portfolio Standard so that a biomass power industry can be developed in Arizona. Specifically the ACC should consider the following action items:

- ***ELIMINATE THE EXPIRATION DATE FOR THE EPS.***
- ***RAMP UP THE RENEWABLE ENERGY MIX FROM 1.1% TO 10% OF ARIZONA'S ENERGY USAGE.***
- ***RECOGNIZE BIOMASS POWER GENERATION AS A VIABLE RENEWABLE ENERGY SOURCE.***

Map 1. Forest Cover Map of Arizona

The following map illustrates the distribution of the 27% of the Arizona's landscape that is made up of forested ecosystems. Consisting primarily of ponderosa pine forests and pinon/juniper woodlands, there are also small areas of fir/spruce, western hardwoods and chaparral vegetation types.

ARIZONA FOREST COVER MAP

